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基于蓝牙4.0的低空航测直升机平台研究

Low-altitude aerial survey helicopter platform based on
Bluetooth 4.0 Version

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摘 要

航空摄影和测量技术作为空间信息技术体系的分支之一，得到了各国的重视，我国在该领域也取得了一系列重大的进展，研制出许多航空摄影测量设备。小型无人机航空摄影测量系统具有运行成本低、执行任务灵活性高等优点，正逐渐成为航空摄影测量系统的有益补充和空间数据获得的重要工具之一。随着航空摄影和测量技术的不断发展，对于搭载光学器件及传感器的飞行器及其控制系统，也提出了更高的要求。飞行器的飞行平稳性、有效续航时间、遥控的方法等因素都对遥测结果产生影响。

本文“基于蓝牙 4.0 的低空航测直升机平台研究”，开发了由共轴双桨直升机、基于 iPhone 4S 手机的蓝牙 4.0 飞行控制器、基于红外编解码技术的飞行控制器组成的低空航测平台。在苹果公司 iOS 5 操作系统下，开发蓝牙 4.0 飞行控制软件。同时，为了增加航测直升机遥控距离，对红外编解码遥控方法做了相关的研究和探索。本研究延长直升机续航时间，增加飞行平稳性，使该共轴双桨航测直升机能更好地应用于航空摄影和测量领域。本文主要作如下几方面的研究：

（1）本研究对低空航测直升机平台进行整体设计与介绍，阐明系统工作原理，选取适合于本平台的硬件电路、软件算法。

（2）分析了蓝牙 4.0 版本的技术特点和应用，开发了基于 TI CC2541 蓝牙芯片的航测直升机系统电路板，包括蓝牙天线设计、传感器模块电路、陀螺仪电路等。在内置蓝牙 4.0 模块的 iPhone 4S 手机上开发飞行控制软件。

（3）根据共轴双桨直升机的空气动力学原理，提出一种双桨联立的数字式 PID 算法，以陀螺仪获取的机身偏转角作为反馈量，运用 PWM 直流电机调速技术控制主辅螺旋桨转速，实现航向的控制。

（4）分析了增加红外遥控距离的方法和红外编解码的技术，设计基于 HS0038 一体化红外接收头的飞行控制方案。

（5）对航测直升机平台和地面两种飞行控制设备的系统功能进行实验和测试。结果表明该航测平台有效操控距离达 200 米，航测直升机能够完成 3 组飞行动作，接收到传感器的检测信息。

关键词：蓝牙 4.0 低功耗技术；共轴双桨直升机；红外编解码；数字式 PID 算法；

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Abstract

As a branch of the spatial information technology, Aerial survey technology attracts international attention. Our country has taken a series of great achievements in this field and developed a number of aerial survey equipments. Small unmanned aerial vehicle (SUAV) photography and measurement systems has the advantages of low operating costs, flexible task perform, hence it has gradually become a useful complement of aerial survey system and become an important tool for the spatial data acquisition. As the fast development of aerial survey technology, it sets higher requirement for the aircraft which equipped with optical devices and sensors and its control system. Flight stability, cruising duration, remote control method will all have a significant impact on telemetry results.

This paper named as 'Low-altitude aerial survey helicopter platform based on Bluetooth 4.0 Version', has developed a low-altitude aerial survey platform which consists of a aircraft modeled in coaxial helicopter, a control device based on iPhone 4S which has a Bluetooth 4.0 module and a control device using IR codec technique. Under the Apple's iOS 5 operating system, I developed flight control software of Bluetooth V4.0. Simultaneously, in order to increase remote control distance of the survey platform, some researches and exploration have been done about infrared codec technology applied to the system. This study extends the aerial vehicle effective cruising duration, increases the flight stability and makes the coaxial helicopter better applied in the aerial photography and measuring field.

The specific research activities completed in this paper are as follow:

This research makes the overall design of the low-altitude aerial survey helicopter platform, explains the working principle of the system and selects suitable hardware circuit and software algorithm for the platform.

This paper analyses the technical characteristics and application of the bluetooth v4.0 and designs a circuit board of aerial survey helicopter system based on CC2541 chip, including Bluetooth antenna, sensor, gyroscope circuit module circuit, etc. Based on the iPhone 4S mobile phone. The built-in Bluetooth v 4.0 module of flight control software is developed.

According to the aerodynamics principle coaxial helicopter, a new pulse width modulation(PID) algorithm Taking deflection Angle of the fuselage captured by Gyroscope as feedback is put forward ,which concerns two rotary wings simultaneously to control the deflecting angle. The PWM technology for speed-control of DC motor is utilized to control the cruising direction.

Several methods to increase the infrared remote control distance are analyzed, so is the principle of the IR codec. This paper designs a flight control scheme based on integrate infrared receiver named HS0038.

System functions of the aerial survey platform are tested. The test results show that the aerial platform effectively control distance are above 200 meters and the helicopter are able to complete the three groups aerial helicopter flight maneuvers, iPhone 4S can receive detection information airborne sensors.

Keywords: Bluetooth v4.0 Low Energy; coaxial helicopter; IR codec; PID algorithm

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